No. LXV.

Experiments and obſervations, on the atmoſphere of marſhes. By ADAM SEYBERT, M. D.

Read, Dec. 21ſt, 1798. WHEN inquiries which have attracted the attention of a Franklin, a Prieſtly, an Ingenhouz and many other eminent perſons, without being decided, are undertaken by one whoſe abilities are ſo far inferior as mine, little ſucceſs can be expected. This remark announces the difficulty of the ſubject I am about to inveſtigate; nevertheleſs I am ſtimulated by the induſtry of my predeceſſors, and if I cannot promiſe much new matter, I hope to be at leaſt able to verify ſome obſervations and perhaps diſprove others; for in proportion as we remove errors we approach nearer to truth.

When we are fully perſuaded, that to live and to breathe are ſynonimous terms; and that the abſolute neceſſity of air to the maintenance of animal life has been fully eſtabliſhed by repeated and well concerted experiments, we need not be ſurpriſed to find many perſons engaged in an examination of the chemical qualities of our atmoſphere: the names of Scheele, Prieſtly, Lavoiſier, Fontana, &c. will for ever make this branch of ſcience reſpectable.

From the earlieſt ages it has been ſuppoſed that the atmoſphere has great influence on the human body in producing diſeaſe, as well as in reſtoring health; hence the accounts of Hippocrates, Sydenham and Huxham. Phyſicians ought always to notice the ſtate of the atmoſphere during the prevalence of epidemic diſeaſes.

Before facts were collected and experiments well performed, the atmoſphere was ſuſpected to differ materially in almoſt every ſituation; but latter experiments have proved that our notions have been erroneous to a great degree.

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In a former memoir which I had the honour to read before this ſociety, I paid particular attention to the atmoſphere over the ocean, rivers and neighbouring land, and hope that my experiments have been of ſome ſervice towards the eſtabliſhment of truth; in the preſent eſſay I intend giving an account of ſome experiments which I performed at different times on the air over marſhes.

A few general remarks reſpecting the common ſtate of our atmoſphere, perhaps become neceſſary for the ſake of future compariſons.

We no longer believe, for experiments have taught us the contrary, that our atmoſphere is an homogeneous element: the preſent ingenious doctrines of heat have thrown much light upon the ſubject; and with much reaſon ſome philoſophers are induced to believe "that the aeriform ſtate is a modification of bodies, dependent on the degree of temperature, and on the preſſure which theſe bodies undergo!"* This opinion has been extended ſo far as to induce ſome to ſay, "Perhaps alſo metals are contained in the atmoſphere."† Theſe ſentiments do not appear to be merely conjectural, for Chaptal has precipitated mercury from oxygen gas (which was obtained from red precipitate) by means of ice; and the family of Achard, ſuffered ptyaliſm from breathing in an atmoſphere where mercury had been expoſed for ſome time in a ſaucer.

The above opinions, if true (and I think them highly probable) prepare us to meet many difficulties in the analyſis of the atmoſphere. But all I expect to do is to open the paſſage, and I ſhall leave others to render it more certain; for numerous experiments, and thoſe often repeated, are the only means whereby we can aſcertain truth; and I fear the labours of one man are inſufficient to perform this taſk.

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* Lavoiſier's Elements of Chemiſtry, p. 59.
† Gritauner's Antiphlogiſtiche Chemie, p. 58.

I am not without hopes that others will engage in the inquiry, it is of importance to every citizen, more eſpecially ſince we find that our principal cities are almoſt yearly afflicted with a terrible epidemic, which has been by ſome attributed to the ſtate of the air. Future diſcoveries it is hoped will multiply the number of teſts for airs, and thus render the ſubject more eaſy.

Reſpectable chemiſts have determined the component parts of our common atmoſphere to be

Oxygen gas 27.
Azotic gas 72.
Carbonic acid gas 01.

Any deviation from this ſtatement muſt be attributed to local circumſtances.

I ſhall firſt endeavour to determine, whether or not the air of marſhes differs from that of other ſituations:

2. What are the cauſes of the differences which are found to exiſt: and

3. Make a few obſervations and remarks.

1. March 31ſt, 1798. Air was obtained by agitating ſtagnant water over marſhy grounds; the following experiments were then performed.

a. It burned when a candle was applied to it; the flame was blue: it did not explode when mixed with atmoſpheric air.

b. Agitated with lime water, a copious white precipitate was formed.

c. Its bulk was conſiderably diminiſhed by agitating it with lime water.

d. Equal bulks of it and nitrous gas were introduced into my eudiometer tube, and a diminution of $\frac{2}{100}$ of their bulk was perceptible.

Theſe experiments were frequently repeated and the reſults were ſimilar to the above-mentioned: they warrant the following inferences:

a. That carbonic acid gas enters largely into the compoſition of the air examined.

b. That hydrogen gas is an ingredient in it.

c. That no oxygen gas was preſent: for the ſmall abſorption which took place, I attribute to the action of the water with which the airs were agitated.

The above experiments were performed on the air, which was obtained immediately as it was diſengaged from the marſhy ſoil; it became neceſſary to examine the air ſituated at ſome diſtance above the marſh.

At different times during the ſummer of 1798, I collected air from above marſhy grounds: the following experiments were performed on it.

a. When agitated with lime water, it afforded a precipitate, which was not ſo abundant as in the former experiments.

b. Mixed with nitrous air, its bulk was diminiſhed to almoſt as great a degree as the air in the yard of my lodgings.

c. Either pure or mixed with atmoſpheric air, it did not burn or explode when a candle was applied to it.

Hence it appears that the air obtained at the height of ſeveral feet above marſhes,

1. Contains little or no hydrogen gas.

2. That the proportion of carbonic acid gas is pretty conſiderable; and

3. What is of great conſequence to be obſerved, a large quantity of oxygen gas enters into its compoſition.

The laſt mentioned facts induce us to believe that the air *above* marſhes is not conſiderably different in its properties from the common atmoſphere in other ſituations, where animals reſpire with eaſe and enjoy perfect health, except the proportion of carbonic acid gas being greater; and this I am induced to believe diminiſhes in quantity as we aſcend: for facts related by travellers who have viſited the Grotto

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del Cane and other ſimilar places, prove that the gravity of this elaſtic fluid permits it to riſe but to an inconſiderable height.

After having proved that certain qualities do exiſt in the air over marſhes, which are different from thoſe poſſeſſed by the atmoſphere in other ſituations, we muſt next attend to our

Second object, viz. to aſcertain what are the circumſtances about marſhes which produce ſuch effects?

Before we proceed any further, it is of the greateſt importance to be ſatisfied reſpecting the changes which may be produced on common atmoſpheric air, when ſubjected to the action of the ſoil of marſhes.

At different times in the months of September and the commencement of October 1796, I expoſed atmoſpheric air to the action of mud, which I obtained from marſhes below the city. The ſame was done at different times in the months of April and July, 1798. The experiments were expoſed to the temperature of the atmoſphere. The reſults from the different experiments were ſimilar. The air was expoſed to the action of the mud which was contained in a tumbler, by means of an inverted glaſs jar, in a baſon containing a ſmall quantity of water. The following changes were noticed.

1. The air contained in the jar became much diminiſhed in bulk, as was proved by the water riſing into the jar.

2. The air, thus acted upon, when agitated with lime water, afforded a copious white precipitate and became diminiſhed in bulk.

3. In ſome of the jars, were ſuſpended papers, ſtained blue with litmus and yellow with turmeric, the blue received a reddiſh tinge and the yellow remained unaltered; the red was again changed to a blue by expoſure to the vapour iſſuing from a bottle containing ammoniac.

4. The air thus altered by the mud, when mixed with nitrous gas in the eudiometer tube, was in every inſtance

found to have loſt in point of purity; ſometimes no diminution of bulk whatever took place.

The following circumſtances ſeemed to influence the laſt mentioned experiments. 1ſt. Temperature. 2d. The length of time during which they were continued. And 3d. The proportion which the mud and air bore to each other, the ſurface of the mud being more or leſs extenſive, ſeemed alſo to have its effects.

The air thus affected by the action of the mud would in no inſtance burn or explode, when a candle was applied to it; hence it contained but a ſmall quantity of hydrogen gas.

This laſt mentioned fact induced me to engage in an eſſay to determine the origin of the hydrogen gas which abounds in the *air obtained by agitating ſtagnant waters.*

It is neceſſary to be obſerved, that in the above experiments with mud, but a ſmall proportion of water was added to it in the tumbler, the quantity was juſt ſufficient to promote putrefaction. I am of opinion that the hydrogen gas is afforded by a decompoſition of the ſtagnant water, effected by the putrefaction of the dead animal and vegetable ſubſtances, which enter largely into the compoſition of the ſoil of marſhes. I was induced to form this opinion, becauſe, firſt, pure water is a compound of but two elements, conſequently the affinity cannot be broken but by the action of a third ſubſtance. And ſecondly, we have no experiments which prove that pure water has undergone ſpontaneous decompoſition. My ideas are confirmed by a fact well known to all ſeamen, viz. when a candle is applied to the bung hole of a caſk containing *river water*, which had been for ſome time cloſely ſtopped, an elaſtic fluid eſcapes, which will inflame and appears in all reſpects ſimilar to hydrogen gas obtained by other means.

After forming the above conjectures, I determined to perform a few experiments which might tend to confirm or diſprove my opinion. With this view mud and water, with

with a very ſmall portion of atmoſpheric air, were at different times confined in bottles cloſely ſtopped and inverted over water: in ſome inſtances the experiment was continued during 20 and 30 days. They were ſubjected to the temperature of the atmoſphere. During the progreſs of the experiments, I perceived that an elaſtic fluid was diſengaged from the materials contained in the bottles, and that the water was evidently diminiſhed in bulk; the elaſtic fluid generated during theſe experiments, 1ſt, inſtantly formed a copious white precipitate when agitated with lime water; 2dly, it burned, when the flame of a candle was applied to it, and poſſeſſed the other properties, which are common to air obtained by agitating ſtagnant waters over marſhes.

Theſe facts are deciſive to me on the ſubject, and confirm the above conjectures reſpecting the origin of the hydrogen gas diſengaged from marſhy grounds. It is neceſſary to remark, that ſome danger attends theſe laſt experiments; for a large bottle which was cloſed by a ground ſtopper, was broken on the 25th day of the experiment, by an expanſion of the contained elaſtic fluid: the pieces, which were large, were thrown to the diſtance of 20 feet, and a report was heard louder than that from the firing of a muſket. In general, the bottles had corks faſtened by means of ſtrings bound round them: as ſoon as I cut the ſtrings, the corks were forced from the necks of the bottles with conſiderable violence.

The above experiments teach us that mud vitiates the atmoſphere in a very powerful manner. They alſo enable us to account for the preſence of the elaſtic fluid forming the atmoſphere of marſhes. It appears, that, the carbone of the mud unites with the oxygen of the decompoſed water, and forms the carbonic acid gas, whilſt the hydrogen gas is ſet at liberty. Theſe are truths not to be invalidated by gratuitous aſſertions, ſince their baſis is experiment.

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It may be aſked, if mud ſeizes oxygen gas with the avidity ſtated, how comes it that eudiometrical experiments prove the air over marſhes to be nearly, if not quite, of the ſame degree of purity as that of other ſituations?

At firſt an anſwer to this important queſtion may ſeem difficult; but ſome examination of the circumſtances attending the ſituation of marſhes, enables us to account for it in a very ſatisfactory manner. It is to be remarked that in my trials with mud, the air was confined under glaſs veſſels over water, conſequently no circumſtances from without could have any influence on the experiments. The air over marſhy ſituations is very different, it poſſeſſes all the advantages of ventilation, &c. in common with the atmoſphere. Beſides theſe circumſtances, a large quantity of oxygen gas is afforded by the living vegetables which ſurround them in abundance. We may alſo obſerve, that frequently large ponds of water are found in their neighbourhood, and that often rivers are at no great diſtance from them: may not therefore a quantity of oxygen gas be diſengaged from theſe waters by the action of the ſun? Experiments are related by reputable authors, wherein water has been decompoſed by the action of the ſun's rays; of this more hereafter.

That the atmoſphere of marſhes, therefore, differs in certain circumſtances from that of other ſituations, and that the ſoil has conſiderable effect, in altering the air of the atmoſphere, I think, cannot be doubted. Let us therefore endeavour to diſcover the particular local cauſes which give riſe to theſe variations.

I have before hinted that the putrefaction of the animal and vegetable matters upon the ſoil of marſhes, was the great cauſe of the changes obſerved to exiſt: for every ſpecies of ſoil will not operate in the manner alluded to.

That the cauſe is in the putrefaction of theſe matters, and that this ſtate is abſolutely neceſſary to thoſe changes, I infer

infer from the following circumſtance; marſhes have no noxious influence, during the winter ſeaſon. They cauſe diſeaſe when the circumſtances are preſent which promote putrefaction; as, a proper degree of heat, a due quantity of moiſture and the contact of atmoſpheric air or ſubſtances capable of affording oxygen; as *water*. That a certain degree of moiſture is neceſſary, appears evident from White's experiments, related in the Philoſophical Tranſactions: he ſays, "a certain degree of moiſture ſeems neceſſary to produce the bad effects of marſhes; for mud when perfectly dry did not alter the air." He might have added, that too much fluidity will likewiſe prevent their bad conſequences, which is proved by the neighbourhood being healthy when they are overflowed. An overflow of water may operate by preventing the powerful effects of the ſun. Experience teaches us, that their bad effects are diſcontinued, when they become dry. Covering them with clay and other ſubſtances not liable to putrefaction, deſtroys their bad effects, ſo does cultivation, froſt, &c.

Living trees being planted in their neighbourhood renders the ſituation more healthy, by abſorbing the gas exhaled during putrefaction and affording oxygen gas.

White's experiments prove, "1ſt. During ſixteen hours, air confined in a phial over water did not ſuffer a change. 2dly. Pure clay moiſtened did not alter the purity of the air. 3dly. Sand moiſtened did not change the purity of the air." But 4th. *Mud (which conſiſts of earths intimately mixed with dead animal and vegetable ſubſtances) rendered the air very impure, as I proved by the experiments which I performed.*

The following reflections occurred to me ſome time ſince, and are copied from my note book.

To arrive at any certain knowledge reſpecting the manner by which marſhes can be ſuppoſed to affect the atmoſphere, we muſt inveſtigate their compoſition.

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They ſeem to conſiſt of;

1ſt. More or leſs water. 2dly. Different proportions of *dead* animal and vegetable matters. And 3dly. The earthy ſubſtances compoſing the original ſoil.

Animals and vegetables, when they have ſuffered death, are ſubject tó the laws which govern inanimate matters in general, and they are liable to the various changes produced by chemical mixture and the laws of chemical affinity: they are acted upon by the powerful agents of nature, and thus ſuffer decompoſition and form new combinations.

All chemiſts acknowledge the analyſis of animal and vegetable ſubſtances to be imperfect. Lavoiſier has paid particular attention to the ſubject. He performed numerous and accurate experiments to determine their compoſition, and notices in a particular manner the reſults they afford during their putrefaction. According to him, they conſiſt chiefly of hydrogen and oxygen, combined with carbone: theſe ſubſtances, he ſays, are found in all vegetables, and none exiſt without them. Animal ſubſtances contain more hydrogen and azote than vegetables do, they alſo have carbone as a conſtituent part of their compoſition: ſome of both claſſes contain ſulphur and phoſphorus.

The above are the principles which I ſuppoſe are liable to be acted upon, and thus produce the effects we are about to conſider.

Before we can underſtand the changes to which the above ſubſtances are liable, we muſt take into conſideration, that our atmoſphere is compoſed of the azotic and oxygen gaſes, and a ſmall portion of carbonic acid gas: many view this laſt as adventitious and by no means neceſſary.

Heat, moiſture, the contact of atmoſpheric air and reſt we know are circumſtances attendant on marſhy ſituations during the unhealthy ſeaſons.

A priori, we might be induced to believe that the following phenomena would take place, under the above circumſtances.

1. That

1. That hydrogen gas would be diſengaged. 2. That the oxygen combining with the carbone would form the carbonic acid gas. 3. That azote would unite with a portion of hydrogen and thus produce ammoniac; whilſt another portion of it would, during its combination with oxygen, form the nitric acid. And 4th. That when ſulphur or phoſphorus were preſent, they with hydrogen would form the ſulphurated and phoſphorated hydrogen gaſes.

We ſhall now endeavour to diſcover whether or not theſe elaſtic fluids enter into the compoſition of the atmoſphere of marſhes.

1. Hydrogen gas. Doctor Franklin has long ſince demonſtrated the production of this elaſtic fluid in marſhy ſituations. Ingenhouſz and others have confirmed the truth of his experiments and obſervations.

My experiments convince me that it is produced in a conſiderable quantity, and that it may be eaſily procured by agitating ſtagnant waters over marſhes. It is alſo evident that this gas is in a ſtate of mixture with the carbonic acid gas.

Although we are certain that a large quantity of hydrogen gas is diſengaged from marſhy grounds, we muſt nevertheleſs conclude that it bears but an inconſiderable proportion to the atmoſphere at large; for we find that the air immediately above marſhes will not explode upon the approach of a candle: indeed from its levity we might ſuppoſe that it occupies the inferior ſtrata of the atmoſphere but for a ſhort time.

2. Carbonic acid gas. That this elaſtic fluid enters largely into the compoſition of the atmoſphere of marſhes, is eaſily proved by agitating it with lime water.

3. Ammoniacal gas. The production of this gas during putrefaction, is proved beyond doubt; therefore that it ſhould exiſt in the atmoſphere of marſhes ſeems at leaſt probable, indeed many have inferred conſiderable effects

from its preſence, but as they did not detect it by any teſt with which we are acquainted, their opinion is entirely hypothetical.

The following are the reſults of the means I employed to diſcover whether ammoniacal gas is preſent in the atmoſphere of marſhes. 1. No white clouds appeared, when muriatic acid gas was mixed with air obtained by agitating ſtagnant waters. 2. Slips of paper ſtained yellow by turmeric, were ſuſpended in a bottle containing mud and atmoſpheric air, it remained unchanged; whereas thoſe ſtained with litmus received a reddiſh tinge. 3. I never could perceive the odour peculiar to this alkali, when I viſited marſhes.

The above experiments cauſed me to doubt the preſence of this elaſtic fluid in the atmoſphere of marſhes. I was confirmed in this opinion by the following circumſtances: 1ſt. Ammoniac combines readily with water: it is impoſſible to procure ammoniacal gas over water; therefore we are to ſuppoſe that if this fluid is produced it is immediately abſorbed by the water of the marſh. 2dly. Carbonic acid gas is abundant in the atmoſphere of marſhes. By experiment, I aſcertained that this acid and ammoniacal gas were very prone to unite and form the carbonate of ammoniac. The experiment was performed in a glaſs tube over mercury: as ſoon as the two elaſtic fluids came in contact, an abſorption took place and the bulk of them was conſiderably diminiſhed: at the ſame time the ſides of the tube were incruſted with a white matter, which poſſeſſed all the properties of the carbonate of ammoniac. If ſuch are the phenomena of theſe experiments, why will not ſimilar effects take place in marſhy ſituations?

4. Nitric acid. The experiments and obſervations of Thouvenel and others, have long ſince demonſtrated the production of this acid during putrefaction. If it is formed in marſhy ſituations, its preſence cannot be proved in their atmoſphere, and I am inclined to believe that it is immediately abſorbed by the neighbouring waters.

5. Sulphurated

5. Sulphurated and phoſphorated hydrogen gaſes. If theſe elaſtic fluids conſiſt of hydrogen gas, holding ſulphur and phoſphorus in ſolution, it ſeems probable that they ſhould be generated during the putrefaction of ſuch matters as contain them as conſtituent elements. Although Chaptal in his Memoirs de Chimie, p. 141, obſerves: "Que la boue noire, degagèe de tout vègètal, ne donnoit plus d'air inflammable mais répandoit une odeur de foie de ſoufre." Still he relates no experiment whereby he detected its preſence in the atmoſphere of marſhes. Its ready abſorption by water; marſh air when agitated with a ſolution of the acetite of lead producing no change in it; ſilver not tarniſhing ſooner in theſe than in other moiſt ſituations; and the air poſſeſſing no peculiar ſmell, are all facts which tend to convince me that it does not exiſt; moreover, Kirwan ſays, that hepatic gas united with nitrous air will depoſit ſulphur. I agitated marſh air and nitrous air together in a glaſs tube and no ſuch phenomenon was noticed.

6. Azotic gas. If you burn candles in the air of marſhes, until all the oxygen be abſorbed, and then agitate the remaining air with lime water ſo as to abſorb the carbonic acid, an elaſtic fluid ſtill remains which poſſeſſes the properties of azotic gas.

7th and laſtly. Oxygen gas. A variety of facts prove that oxygen gas is a principal ingredient in the atmoſphere of marſhes; 1ſt, candles burn therein with the ſame luſtre as in other ſituations. 2. Animals breathe with equal eaſe as in other places. 3. Eudiometrical experiments prove that it forms as great a proportion here as in other atmoſpheres which are reckoned more healthy.

Auguſt 4th and 5th, 1796—July 8th and 10th, 1798—I collected air from over marſhy grounds to the ſouth and north of Philadelphia; when tried with the Eudiometer, they always proved as pure as the air in the yard of my lodgings. Chaptal in his Memoirs de Chimie, p. 141.

aſſerts that the air over the ponds, which border on the Mediterranean ſea (the neighbourhood of which is equally marſhy if not more ſo than the neck formed by the junction of Schuylkill and the Delaware, as I convinced myſelf during my reſidence at Montpellier in the years 1795 and 1796) was equally pure with that of Montpellier, tried the ſame day. When I aſſert that the atmoſphere of marſhes is equally pure with that of other ſituations, I mean that it contains as large a proportion of oxygen gas as ſuch other atmoſpheres do. I do not by any means intend to be underſtood that it is free from foreign mixtures.

I have acknowledged that putrefaction is going on in marſhy places and likewiſe admit that this proceſs deſtroys the purity of the atmoſphere by abſorbing its oxygen; therefore it may ſeem difficult to admit the *abſolute purity* of the air being equal here to that of other places. People being able to breathe with eaſe over marſhy grounds, is ſufficient proof that the oxygen gas there is adequate to ſupport life. I ſhall now attempt to account for the purity of the air of marſhes as follows. Sennebier has proved by numerous experiments, that living vegetables placed in an atmoſphere of carbonic acid gas or in water ſaturated with this air, expoſed to the action of the ſun, thrive and grow very rapidly: during the experiments the carbonic acid is deſtroyed and oxygen gas is diſengaged. In addition to theſe experiments, Ingenhouſz has taught us that the aquatic plants, particularly ſuch as grow in the neighbourhood of marſhes, poſſeſs the power above ſtated to a ſurpriſing degree; ſee Experiences ſur les Vègètâux, Tom. 2. p. 401. Theſe facts when properly conſidered and connected with the remarks I made when ſpeaking of the effects of mud on the atmoſphere, I think are ſufficient to account for the phenomenon, which at firſt ſeemed at leaſt doubtful.

The above view of this difficult ſubject will perhaps in ſome meaſure alter our opinions reſpecting the utility of marſhes.

marſhes. Heretofore mankind ſeem to have viewed their exiſtence as noxious to them and unneceſſary to their happineſs. I confeſs my former opinion reſpecting them coincided perfectly with that of the majority, but at preſent my ideas are very different: I conſider them as very neceſſary to keep the atmoſphere in a *proper degree* of purity, for it is not only the impure atmoſphere which kills animals, but the too pure alſo; and an ingenious philoſopher has well obſerved, that animals live too faſt in atmoſpheres overcharged with oxygen gas. They appear to me to have been inſtituted by the Author of Nature in order to operate againſt the powers which vegetables and other cauſes poſſeſs of purifying the atmoſphere, ſo that the oxygen may exiſt in a proper proportion, fit to ſupport animal life and combuſtion. I am of opinion that ere long marſhes will be looked upon by mankind as gifts from Heaven to prolong the life and happineſs of the greateſt portion of the animal kingdom. Perhaps it was originally intended that they ſhould remain uninhabited and that their only uſe ſhould be that of correcting the too pure atmoſpheres. Although their immediate inhabitants ſuffer diſeaſe from them, ſtill but a ſmall portion of the human race chooſe marſhy ſituations for their reſidence.

After I had read the above before the ſociety, a friend in converſation with me, objected to the operation of marſhes on the atmoſphere being intended to prevent a ſuperabundance of oxygen gas; he obſerved that this effect would be fully accompliſhed by the ordinary combuſtion and the reſpiration of animals. Upon reflection, his objections gave riſe to new confirmations of what I aſſerted: I remarked to him, that very extenſive tracts of country were ſufficiently warm without fires; that in theſe places nature gave uncommon powers to vegetable action, but at the ſame time ordained, that, in theſe very ſituations marſhes ſhould be moſt abundant. If we view moſt ſouth-

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ern countries, I believe the above facts will be found to exiſt very generally. A further beautiful demonſtration of my propoſition may be adduced from a well known fact, that when vegetable life becomes paralized in the winter ſeaſon the operation of marſhes is then unneceſſary and is likewiſe ſuſpended by the ſame cauſes, viz. froſt, &c.

An account